



National Aeronautics and
Space Administration



ARSET

Applied Remote Sensing Training

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Satellite Aerosol Validation

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Satellite Remote Sensing of Air Quality

September 19-21, 2017

University of California, Riverside

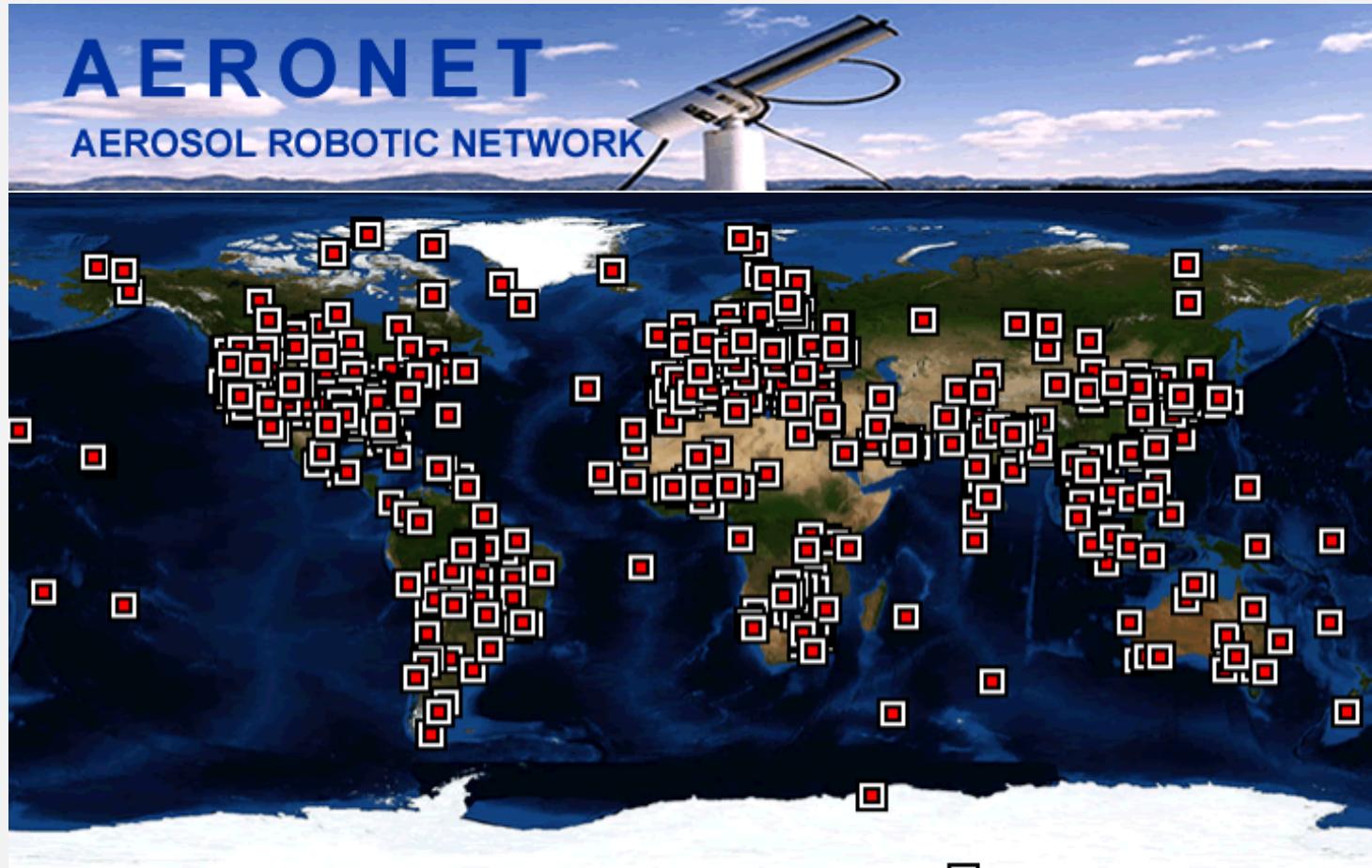
Objectives

By the end of this presentation, you will learn to:

- Validate satellite-derived aerosol optical depth
- List the uncertainties in the MODIS aerosol product
- Access data and tools for validating satellite aerosol products

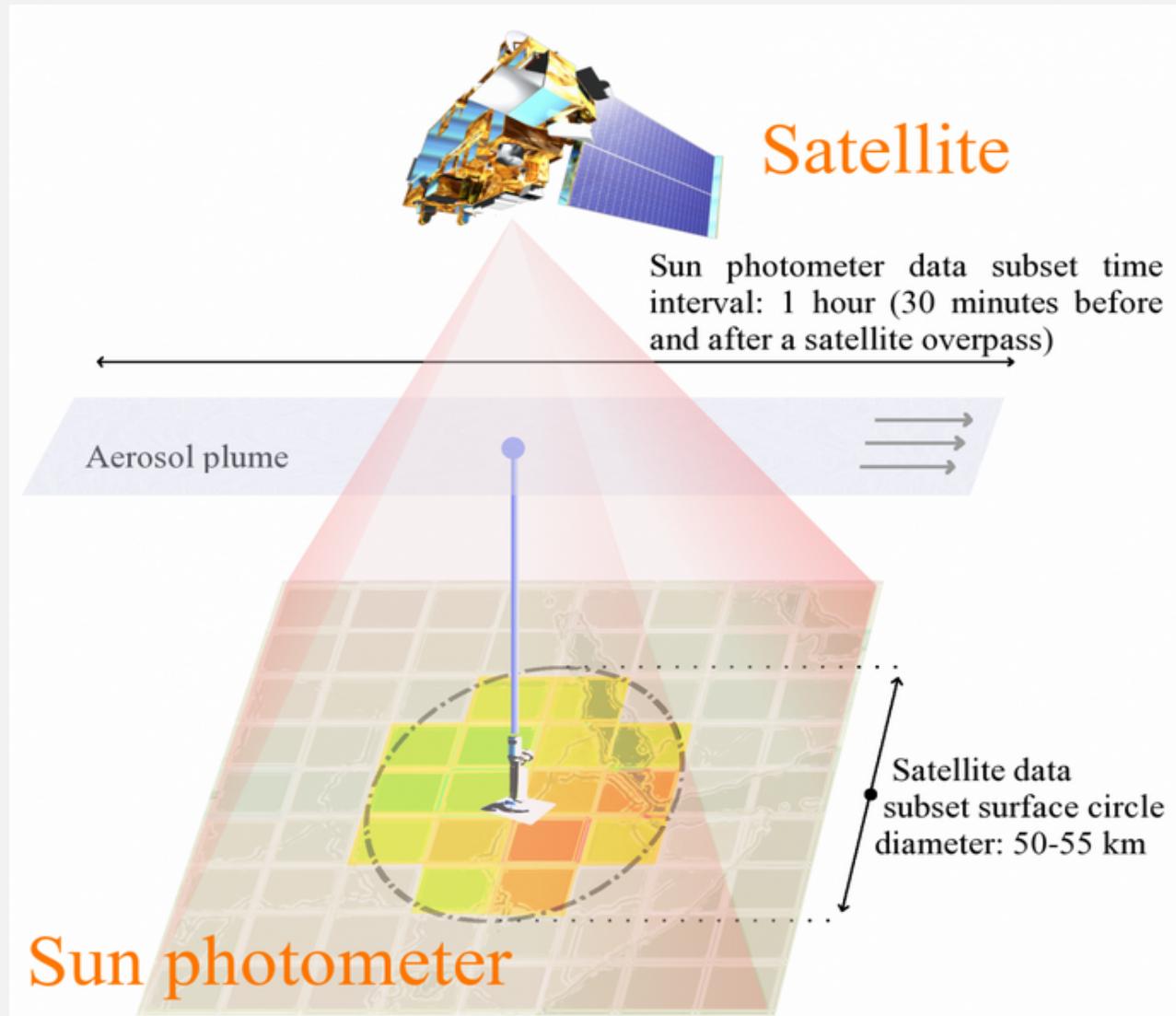
AERONET

<http://aeronet.gsfc.nasa.gov/>

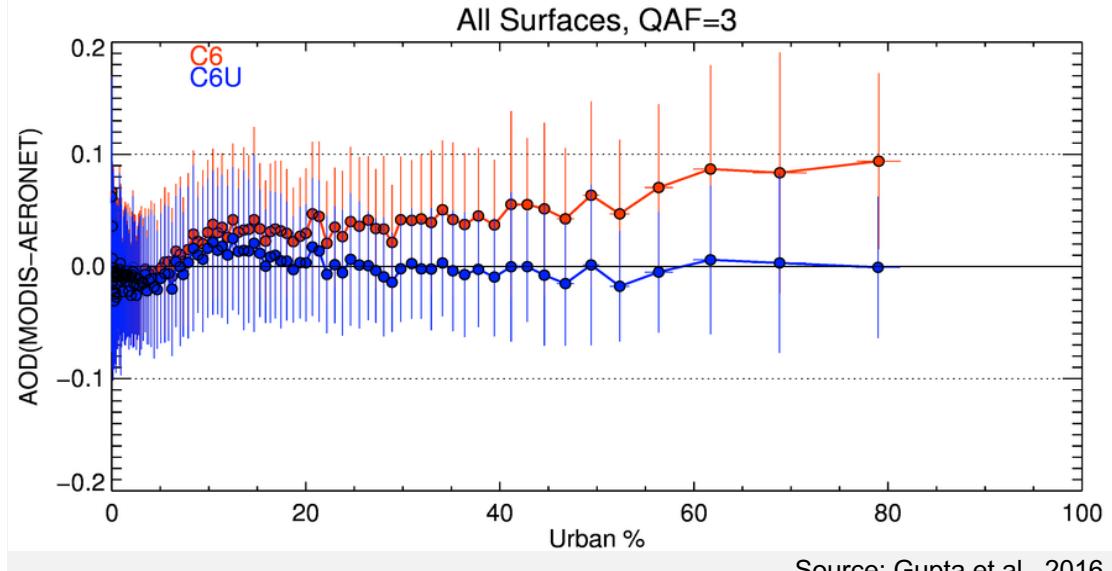
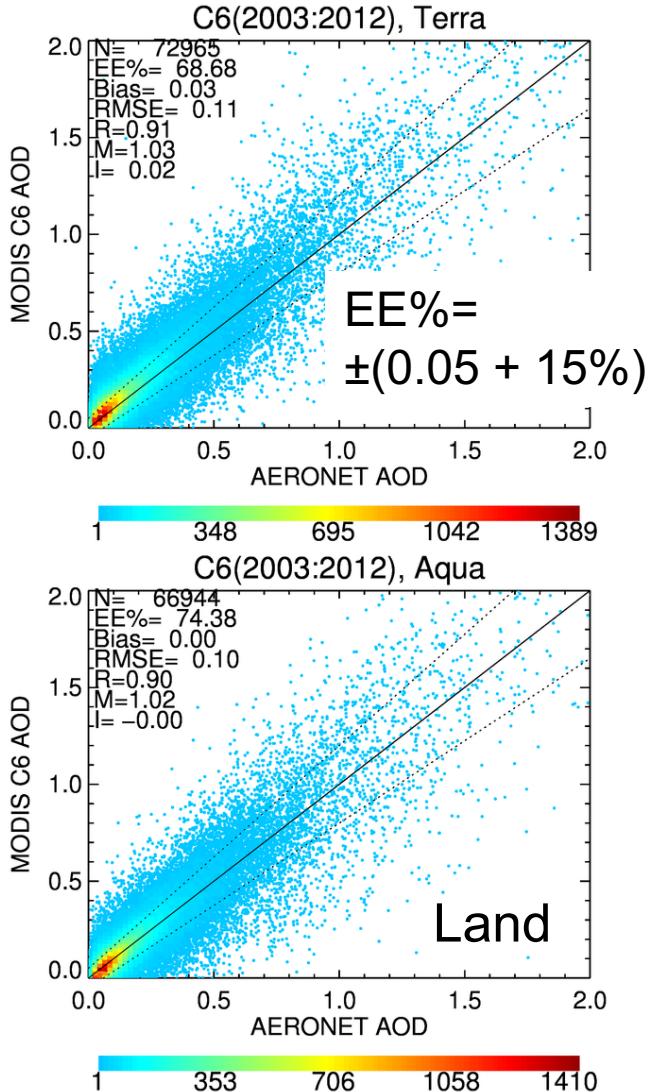


Serves as a validation tool for satellite air quality products

Spatial and Temporal Collocation

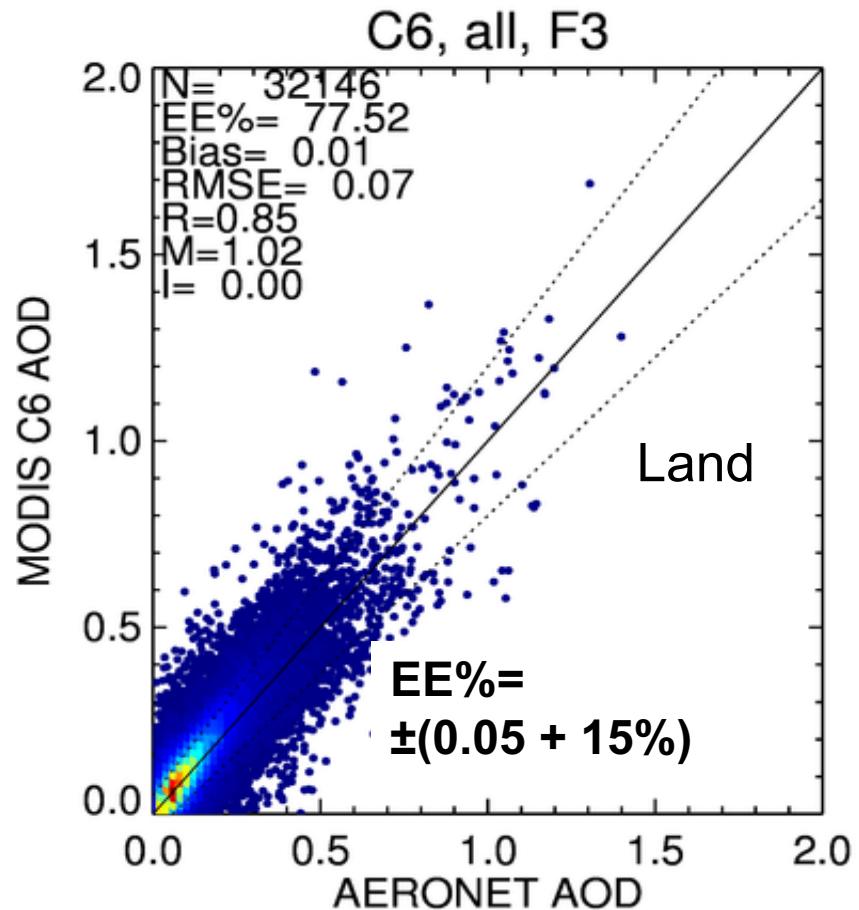
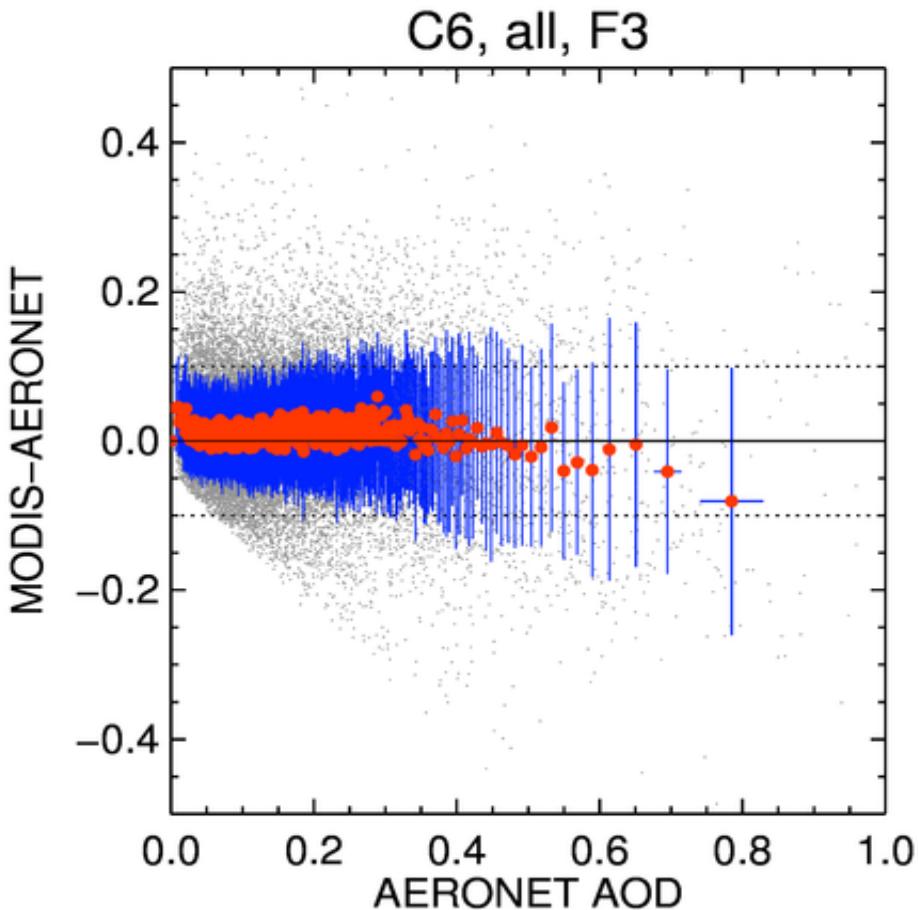


MODIS Dark Target (DT) AOD Validation



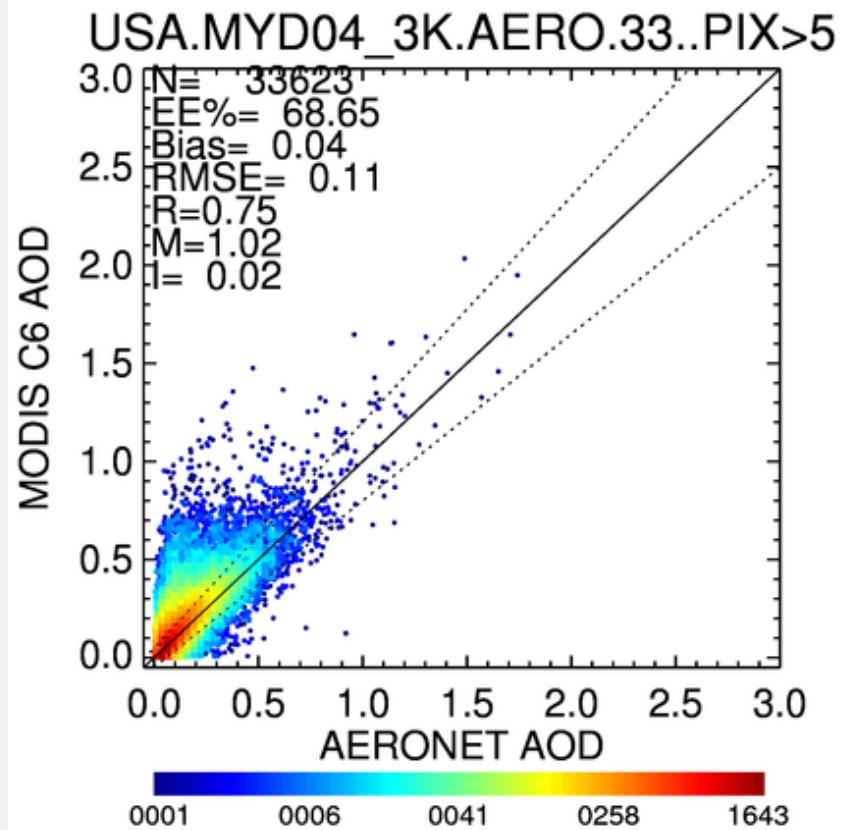
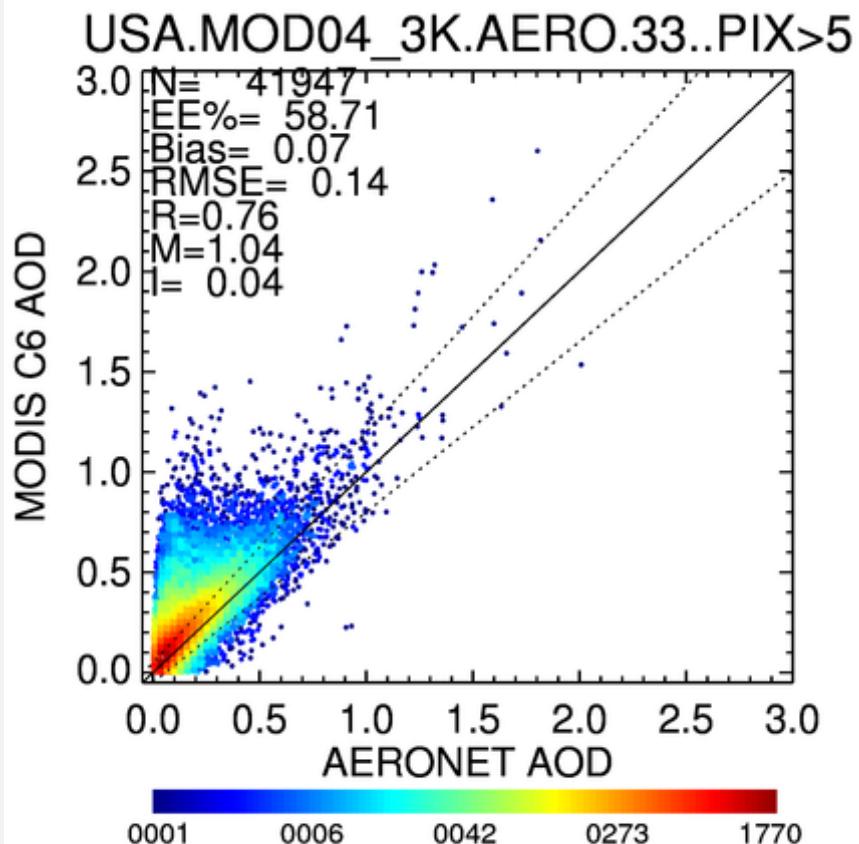
MODIS DT Aerosol Retrieval at 10 km in U.S.

United States



MODIS DT Aerosol Retrieval at 3 km in U.S.

United States



Gupta et al., 2017, in-prep.

Dark Target

<http://darktarget.gsfc.nasa.gov/>

The effect of aerosols is one of the greatest sources of uncertainty in climate modeling. Aerosols vary in time in space and can lead to variations in cloud microphysics, which impact cloud radiative properties and climate. The Dark-Target (DT) aerosol retrieval algorithm is applied to multispectral satellite data, and derives aerosol properties including aerosol optical depth (AOD) over land and ocean, and spectral AOD and aerosol size parameters over ocean. Products of the DT retrieval are used to develop global and regional aerosol climatology, to study the interaction of aerosols with clouds, and for air quality assessments and forecasts.

There are two separate and distinct "Dark Target" (DT) algorithms. The first one is used for retrieving aerosol information over ocean (dark in visible and longer wavelengths) and the second one over vegetated/dark-soiled land (dark in the visible). In theory, these algorithms can be applied

MODIS Dark Target AOD Uncertainties

MODIS 10 Km Product

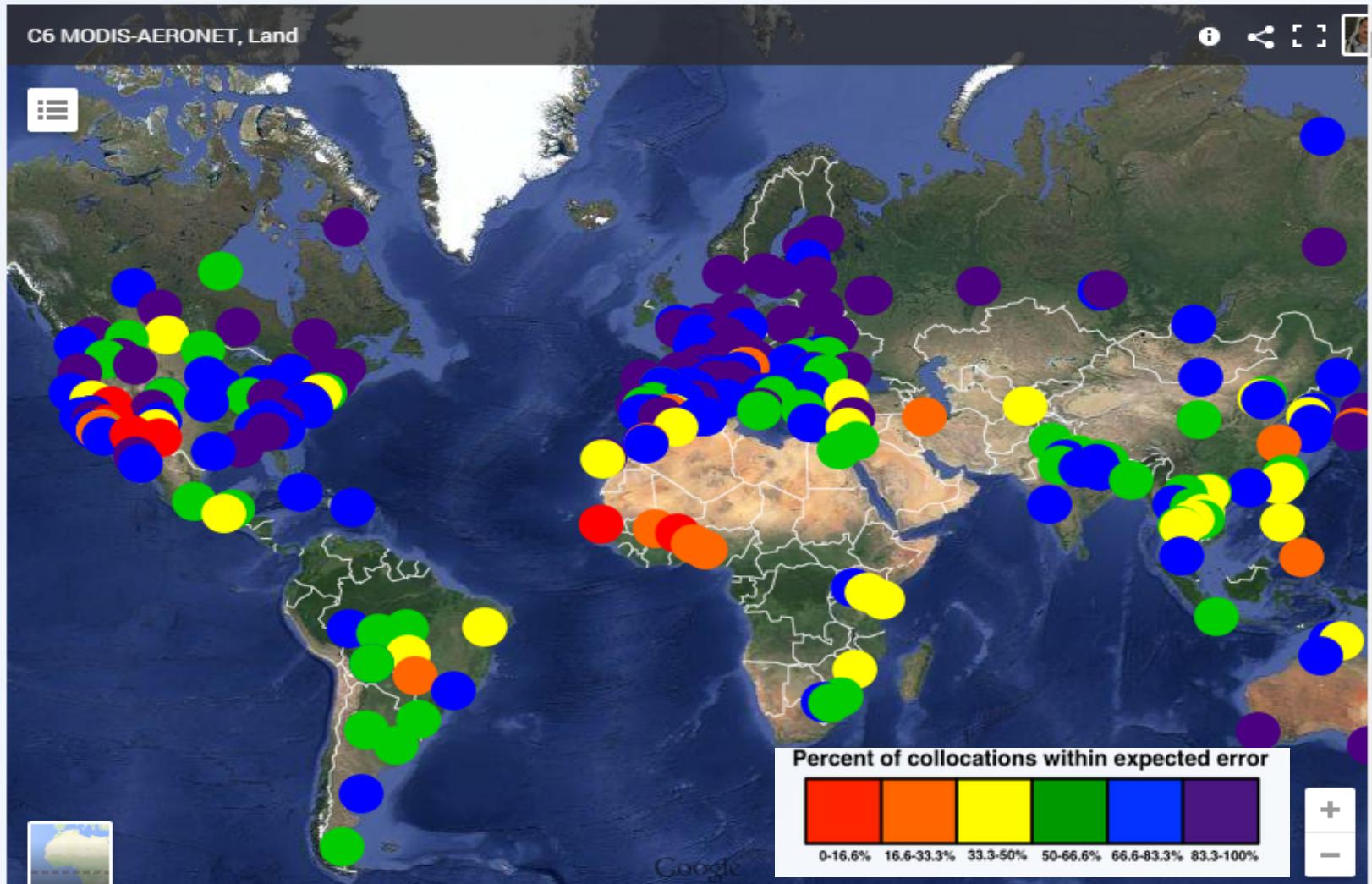
	Collection 5		Collection 6 (Interim Values)	
	Ocean	Land	Ocean	Land
Aqua	+/- (0.03 + 5% of τ)	+/- (0.05 + 15% of τ)	(-0.02 - 10% of τ) (+0.04 + 10% of τ)	+/- (0.05 + 15% of τ)
Terra	+/- (0.03 + 5% of τ)	+/- (0.05 + 15% of τ)	Data not yet available	Data not yet available

MODIS 3 km Product Uncertainty Values for Collection 6 (Interim Values)

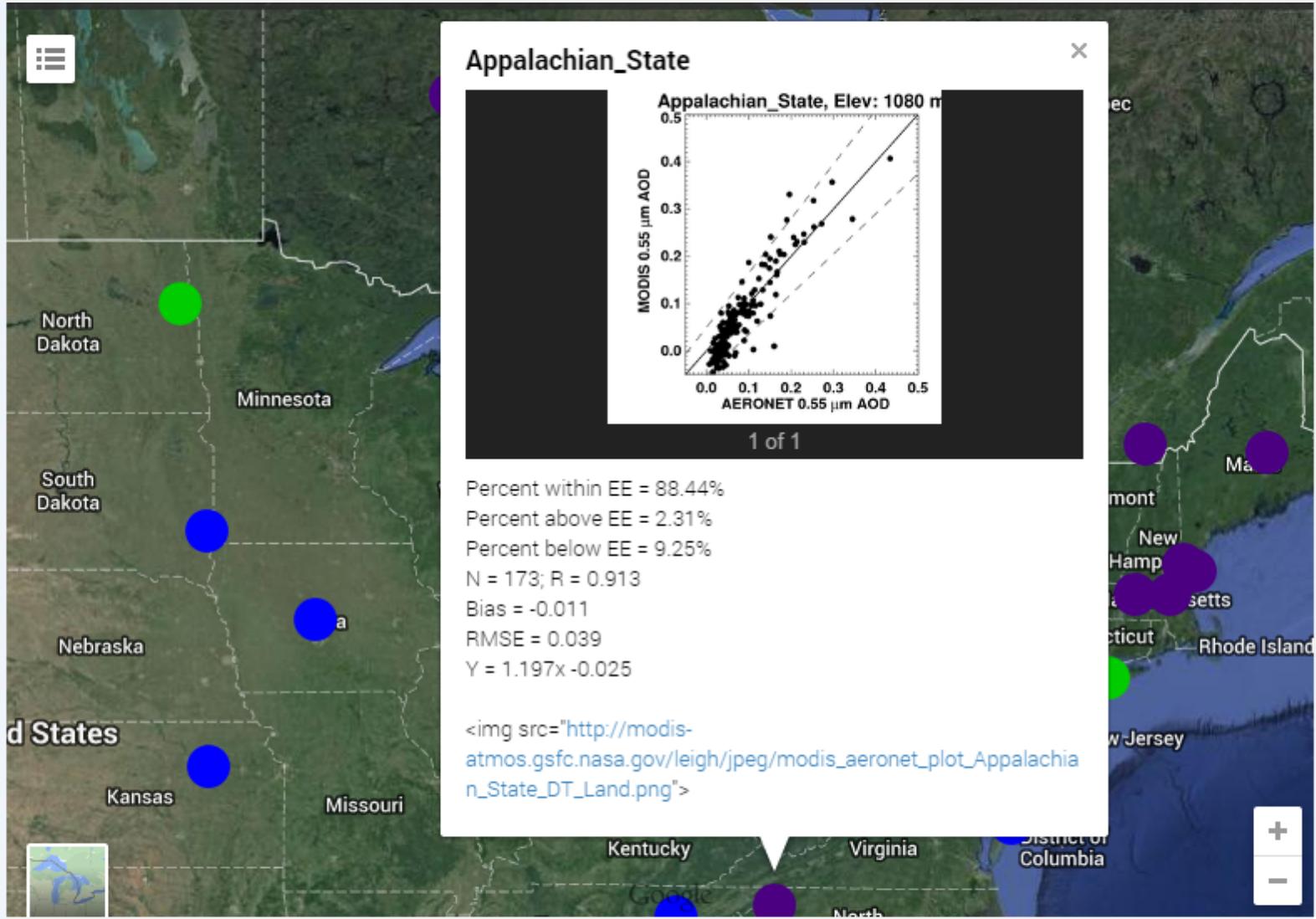
	Ocean		Land
Aqua	+/- (0.04 + 5% of τ)		+/- (0.05 + 20% of τ)
Terra	Data not yet available		Data not yet available

Validation Maps

<http://darktarget.gsfc.nasa.gov/>

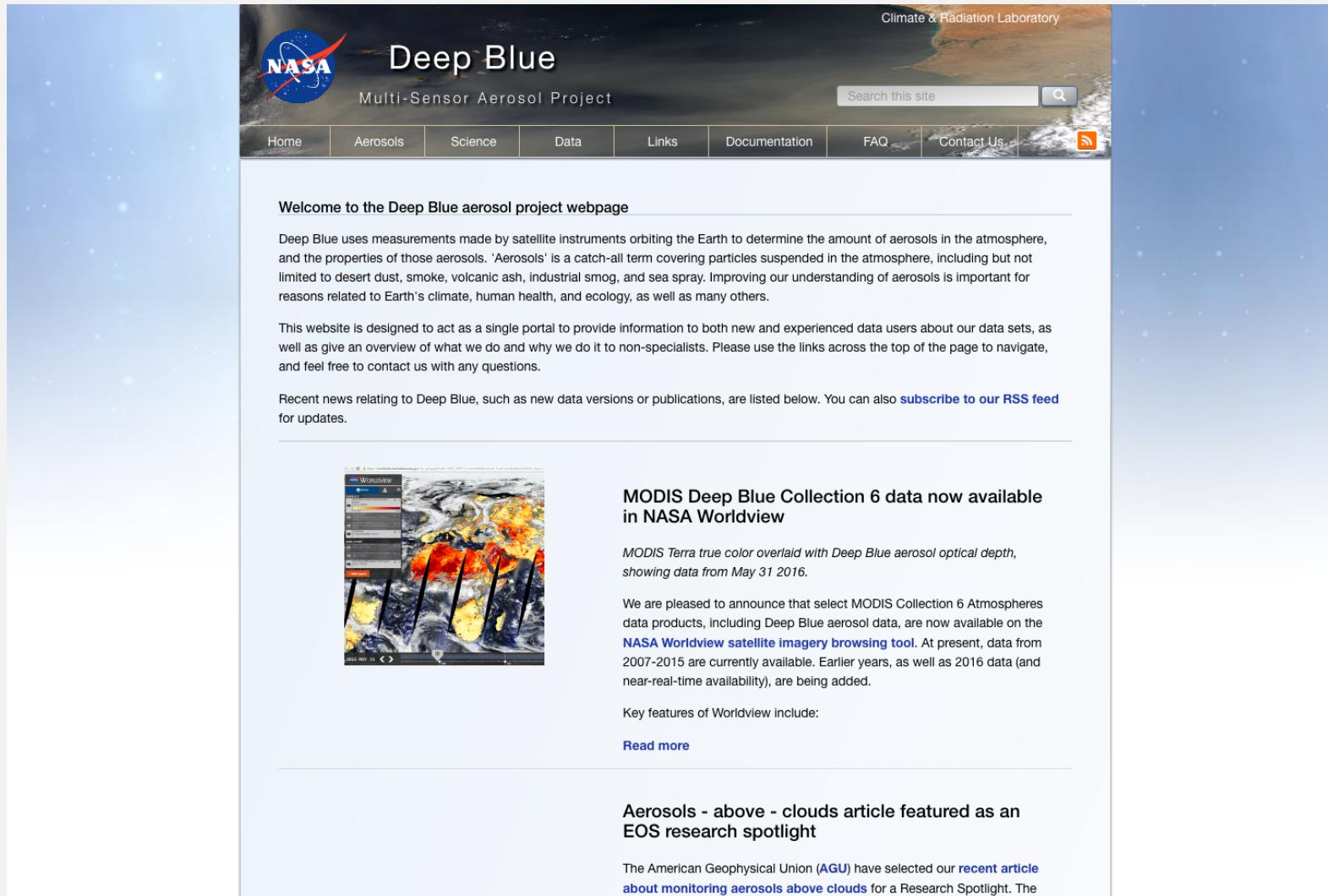


Scatter Plot



Deep Blue Product

<http://deepblue.gsfc.nasa.gov>



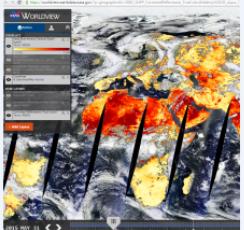
The screenshot shows the homepage of the Deep Blue Multi-Sensor Aerosol Project. The header features the NASA logo, the project name "Deep Blue", and a search bar. Below the header is a navigation menu with links to Home, Aerosols, Science, Data, Links, Documentation, FAQ, Contact Us, and an RSS feed icon. The main content area includes a welcome message, a description of what Deep Blue does, information about the website's purpose, recent news, and a featured section about MODIS Deep Blue Collection 6 data available in NASA Worldview. There is also a link to an EOS research spotlight article.

Welcome to the Deep Blue aerosol project webpage

Deep Blue uses measurements made by satellite instruments orbiting the Earth to determine the amount of aerosols in the atmosphere, and the properties of those aerosols. 'Aerosols' is a catch-all term covering particles suspended in the atmosphere, including but not limited to desert dust, smoke, volcanic ash, industrial smog, and sea spray. Improving our understanding of aerosols is important for reasons related to Earth's climate, human health, and ecology, as well as many others.

This website is designed to act as a single portal to provide information to both new and experienced data users about our data sets, as well as give an overview of what we do and why we do it to non-specialists. Please use the links across the top of the page to navigate, and feel free to contact us with any questions.

Recent news relating to Deep Blue, such as new data versions or publications, are listed below. You can also [subscribe to our RSS feed](#) for updates.



MODIS Deep Blue Collection 6 data now available in NASA Worldview

MODIS Terra true color overlaid with Deep Blue aerosol optical depth, showing data from May 31 2016.

We are pleased to announce that select MODIS Collection 6 Atmospheres data products, including Deep Blue aerosol data, are now available on the [NASA Worldview satellite imagery browsing tool](#). At present, data from 2007-2015 are currently available. Earlier years, as well as 2016 data (and near-real-time availability), are being added.

Key features of Worldview include:

[Read more](#)

Aerosols - above - clouds article featured as an EOS research spotlight

The American Geophysical Union (AGU) have selected our [recent article about monitoring aerosols above clouds](#) for a Research Spotlight. The

MAPSS

Multi-sensor Aerosol Products Sampling System

- Giovanni instances
- Used to evaluate the quality of satellite retrievals
- MAPSS allows you to compare AERONET data with coincident satellite data
- Quick and effective way to evaluate the quality of the satellite retrieval at particular locations for a range of dates or seasons
- Data from MODIS & MISR
 - Satellite-AERONET Inter-Comparison:
<http://giovanni.gsfc.nasa.gov/mapss/>
 - Multi-Sensor Statistics:
http://giovanni.gsfc.nasa.gov/mapss_explorer/

MAPSS: Multi-sensor Aerosol Products Sampling System

This user interface is used to obtain selected parameter statistics from the [MAPSS](#) database for a chosen location and time period. Time Series Plot is the available service. Plot output is rendered as a graph and is also available in ASCII format.

Data Selection Results **NEW** Try out the MAPSS Statistical Explorer

Plot Data Reset Clear Send Us Feedback! Help

Select Station
Click 'Browse' button or type in comma separated names of stations [Browse](#)

Select Plot
Satellite Colocated with AERONET
 Time Series
 Scatter Plot

Select Measurements
Click each list below (beginning with the left-most list) to show the set of fully qualified measurements. Select a measurement to view its details.
 Basic Advanced

Product
AERONET aerosols L2, ver. 2
AERONET deconvolution L2, ver. 41
AERONET inversions L1.5, ver. 2
AERONET inversions L2, ver. 2
CALIPSO column and layer aerosols
[More...](#)

Parameter Layer
Current Result: MAPSS TIME SERIES (6C2294D97C9F) [Load](#)
[View Plots](#) [View Lineage](#) [Download Data](#)
[Problem? Send a report...](#)

MAPSS Time Series

Mean AOD

Jun 1 2008 Jun 9 2008 Jun 17 2008 Jun 25 2008

Legend:

- Mean AOD: Mean of AOD - polarized from P3L2TLGC.K at GSFC
- Mean AOD: Mean of Best AOD at 500nm from OMAERUV.003 at GSFC
- Mean AOD: Mean of AOD at 500nm - total from AERONET_SDA_L2.41 at GSFC
- Mean AOD: Mean of Best estimate of AOD at 558nm from MIL2ASAE.0022 at GSFC
- Mean AOD: Mean of AOD at 550nm - land and ocean from MOD04_L2.005 at GSFC

Measurement
Result 3 - AEROSTAT_SCATTER_PLOT: [View Criteria](#) [Problem? Send a report...](#)

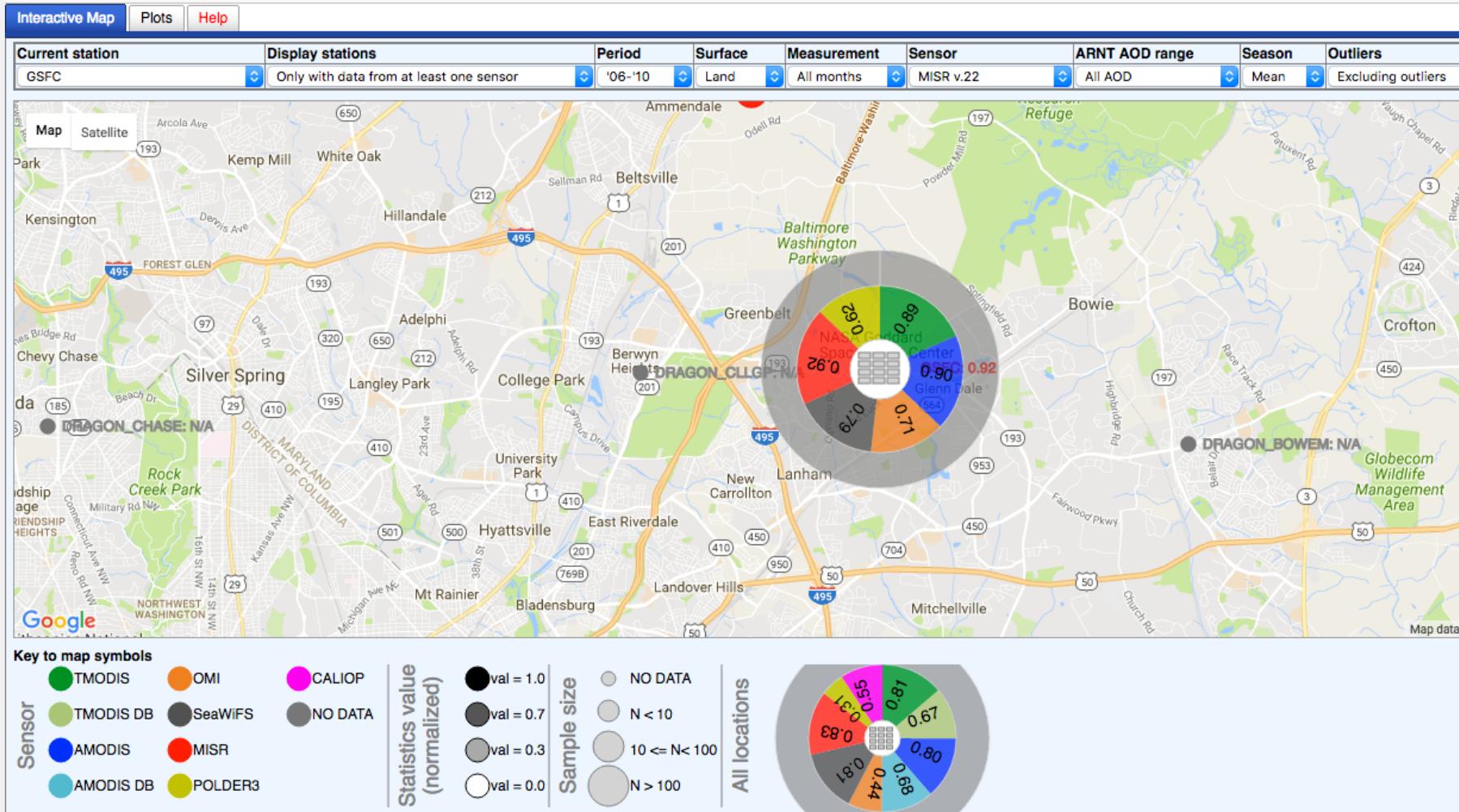
Time Period: 2001-01-01 to 2004-01-01

Mean AOD (tau)

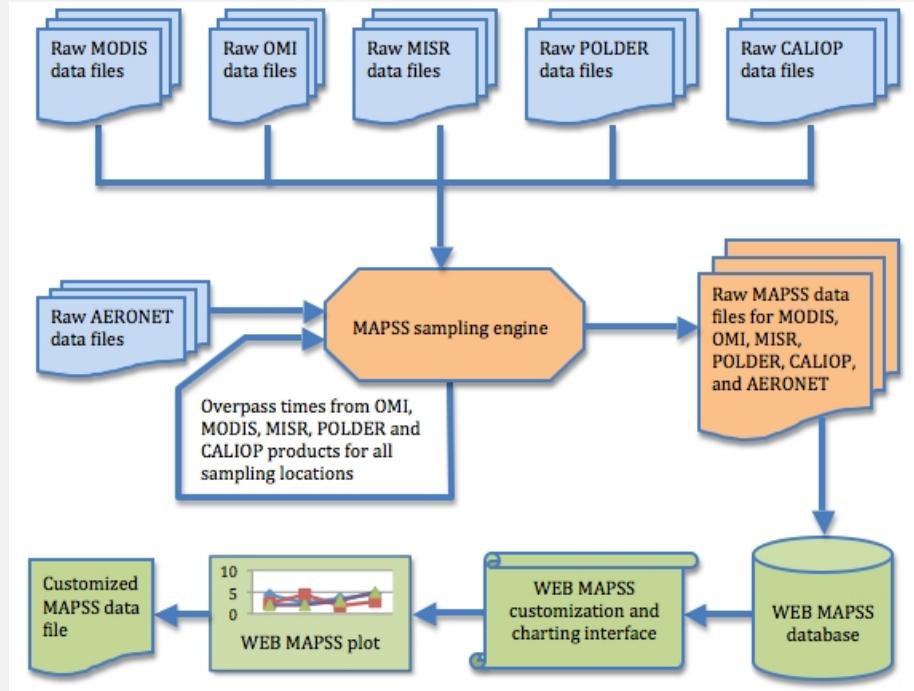
Mean of AOD at 440nm from AERONET_AOD_L2.2 at GSFC (tau)

MAPSS Statistical Explorer

http://giovanni.gsfc.nasa.gov/mapss_explorer/



MAPSS – Further Reading



Petrenko, M., and C. M. Ichoku. 2013. "Coherent uncertainty analysis of aerosol measurements from multiple satellite sensors." *Atmos. Chem. Phys.*, 13 (14): 6777-6805 [10.5194/acp-13-6777-2013] [Journal Article/Letter]

Petrenko, M., C. M. Ichoku, and G. Leptoukh. 2012. "Multi-sensor Aerosol Products Sampling System (MAPSS)." *Atmospheric Measurement Techniques*, 5 (5): 913-926 [10.5194/amt-5-913-2012] [Journal Article/Letter]

Published Validation Results

Levy, R. C., Mattoo, S., Munchak, L. A., Remer, L. A., Sayer, A. M., Patadia, F., & Hsu, N. C.. (2013). The Collection 6 MODIS aerosol products over land and ocean. *Atmospheric Measurement Techniques*, 6, 2989–3034. doi:10.5194/amt-6-2989-2013

Remer, L. A., Mattoo, S., Levy, R. C., & Munchak, L. A.. (2013). MODIS 3 km aerosol product: algorithm and global perspective. *Atmospheric Measurement Techniques*, 6, 1829–1844. doi:10.5194/amt-6-1829-2013

Sayer, A. M., N.-Y. C. Hsu, C. Bettenhausen, and M.-J. Jeong. 2013. "Validation and uncertainty estimates for MODIS Collection 6 "Deep Blue" aerosol data." *J. Geophys. Res. Atmos.*, 118 (14): 7864-7872 [10.1002/jgrd.50600

Sayer, A. M., L. A. Munchak, N.-Y. C. Hsu, et al. 2014. "MODIS Collection 6 aerosol products: Comparison between Aqua's e-Deep Blue, Dark Target, and "merged" data sets, and usage recommendations." *J. Geophys. Res.-Atmos.*, 119 (24): 13,965-13,989 [10.1002.2014JD022453]